

PAVEMENT MANAGEMENT AT MDOT

What is Pavement Management?

Pavement management is defined by the Federal Highway Administration (FHWA) as “a systematic process that provides, analyzes, and summarizes pavement information for use in selecting and implementing cost-effective pavement construction, rehabilitation, and maintenance programs.” In practical terms, a pavement management system (PMS) enables MDOT to collect and maintain pavement data and to use these data for making decisions regarding pavement projects. This means that PMS is based on the idea of finding cost-effective construction and rehabilitation practices to give to the travelling public a desired level of service. Data collection devices and software are integral parts of the PMS; however, they do not make the decisions; they are tools which support personnel in the decision-making process. This document will describe MDOT’s pavement management system—how it began, type of data collected, uses of PMS information, and future enhancements.

How Did Pavement Management Begin?

The FHWA and state DOTs have long recognized the importance of pavement management. Due to the explosive, exponential growth in traffic, particularly heavy truck traffic, over the last 30 years, pavements have been required to carry an ever-increasing load. At the same time, governments are cutting expenditures and attempting to find more efficient ways to construct and maintain pavements while still meeting the travel demands placed upon the roads. Studies have shown that investments in infrastructure reduce costs of transportation and contribute to economic growth. Also, many major routes such as interstates and state highways are aging and therefore need long-term preventive maintenance strategies.

With these ideas in mind, in 1986 MDOT contracted with the University of Mississippi to implement a pilot pavement management system in District 2. A rudimentary database was developed, and it included distress and roughness data collected on the entire state-maintained roadway system in District 2. Upon completion of the contract with the University in 1989, MDOT used the product developed in the pilot program to launch a statewide pavement management system. The database for the statewide PMS was to include inventory and historical information, such as lane widths, roadway lengths, county/route information, as well as construction history (original construction and subsequent overlays). Through the years the mechanisms and software used for the PMS have changed in order to keep up with technology and to make improvements in ease of use; however, the basic uses of the PMS have not changed.

The federal government mandated that states implement a PMS as part of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. This mandate included data collection and management, inventory of physical pavement features, construction history, and condition surveys. The National Highway System Designation Act of 1995 relieved the states of the mandate. However, MDOT continued its PMS efforts since the PMS had been in place prior to the mandate, and since the PMS will be beneficial to MDOT's decision-making processes.

What Types of Data are in the PMS?

Inventory/History: Inventory/history information includes geometric, lane, and crossing route data. This type of data depicts each pavement section's location on the state-maintained system, as well as a physical description of lane configuration. Geometric data consists of uniquely identifying features, such as county, route name, direction of data accumulation, beginning and ending log-mileage, measured length, and number of lanes. Lane information specifies type of lane (such as lane 1, lane 2, right turn lane, etc.), lane widths, and shoulder widths. Crossing route data shows the mileage points of intersecting routes. Inventory/history data are collected by the District offices using a distance measuring instrument (DMI) when a project is completed.

Construction/Rehabilitation: The PMS also keeps track of construction history, both original and subsequent projects. Original construction data includes date of construction, total number of layers, total thickness, and thickness and material properties of each layer (i.e., surface course, base, subgrade, etc.). The PMS also keeps track of rehabilitation projects such as overlays, milling, punchout repair, and slab replacement done on each section. The data includes date and type of rehab and/or resurfacing, as well as the thicknesses and material properties of each course. Construction and rehabilitation project data are maintained by the District.

Pavement Survey: Every two years a pavement survey of the state-maintained highway system is performed. A contractor collects both condition and distress data in order to monitor the overall shape of the state's roadways. Condition data include the following: International Roughness Index (IRI), Pavement Condition Rating (PCR), roughness rating, rut depth, faulting and texture. Distress data such as cracking, potholes, patching, punchouts and joint deterioration are collected on 500-foot samples within each analysis section.

Other Data: Other data collected, typically at District request, include falling weight deflectometer (FWD) and skid/friction data on selected sections. Also, traffic data and project cost (financial) data are contained in the pavement management system. Traffic and project data are not collected by pavement management personnel. Traffic data comes from the Planning Division, and project data comes from the Financial Management Division.

How are Pavement Condition and Distress Data Collected?

Pavement condition and distress data have been collected by a contractor every two years beginning in 1991. The contractor collects the longitudinal profile with a South Dakota profiler, which uses laser sensors. Roughness, rutting, faulting, and texture indices are collected on 100% of the state-maintained system. Five video cameras are mounted to the van to capture images of the shoulders, wheel paths, and perspective views. The images are then digitized, one frame approximately every 50 feet. The van is also equipped with a GPS receiver to collect coordinate data. A distress evaluation (measuring cracking, potholes, punchouts, etc.) is then performed on the video images. rehabilitation projects. The distress evaluation is not performed on the entire highway system. Rather, a sampling technique is used for approximately 20% coverage of the state-maintained system.

How Are Pavement Friction and Deflection Data Collected?

Skid tests are performed, using a skid rig manufactured by K.J. Law, on new construction projects and at the request of the District office. They are also done every three years for each analysis section in the PMS database. On new construction, the skid test is usually scheduled for approximately three months after the completed surface course (main roadway) of the project has been opened to traffic. The three-month period is necessary to allow the asphalt film to wear off the surface of the pavement.

Pavement deflection data is collected at District request using a DynaTest Falling Weight Deflectometer (FWD). Generally a District office will request FWD data collection when they are planning to do an overlay. The FWD measures deflections in the pavement structure. The deflection data is then analyzed by the Research Division, and recommendations are made to the District regarding overlay thickness.

How is Quality Control/Quality Assurance of Contractor-Collected Data Done?

Quality control and quality assurance must be done on the data collected by the contractor (condition and distress data). QA/QC on the condition data is done by the Pavement Management Data Coordinator from the Research Division, who works closely with the Pavement Management Analyst in each District office. Calibration sites are set up in each district based on pavement type. Calibration of the contractor's equipment is

done using MDOT's South Dakota profiler, rut bar, and Georgia Fault Meter, at the beginning of each work day.

QA/QC on the condition data must be done within a few weeks ahead of or behind the contractor's data collection, using a five-percent sampling. The samples are chosen based on pavement type and facility of data collection (i.e., a flat, straight section rather than a hilly or curvy one). Roughness and rut data are collected on the entire homogeneous pavement analysis section using the South Dakota Profiler. The average IRI, rut depth and faulting data (if applicable) for each sample are noted and entered into a database to be used for comparison points.

Distress data are checked for quality using the Image Processing Workstation (IPW) and the video images for a five-percent sample of pavement sections. Distresses checked include cracking, potholes, spalling, and punchouts. If the distresses on the video images do not match those listed for the particular section in the contractor's information, then the contractor must review the section in question.

How Does MDOT Analyze Pavement Data?

Condition and distress are analyzed using a combination of standard practices and procedures developed by MDOT. For example, an IRI (International Roughness Index) is calculated from the profile data. IRI is an indicator of pavement roughness which is generally accepted as an objective standard. However, IRI does not tell the whole story on a given road. For example, the pavement may be very smooth and yet have deep rutting in the wheel path or cracking which will let water in and cause deterioration. Therefore, it was necessary to take all these factors into account when assessing pavement condition.

MDOT has developed a mechanism for quantifying overall health of a section of pavement. The distress data, including severity levels and extent, are used to calculate a Distress Rating of the pavement. This Distress Rating is combined with the International Roughness Index (IRI) to calculate MDOT's Pavement Condition Rating (PCR). The calculation of the PCR involves deduction points from a perfect score of 100 for distresses, roughness, etc. These algorithms were developed using a team of experts who rated the interstate system, as well as statistical analyses performed by the University of Mississippi Civil Engineering Department. Many states have their own methods of rating pavement condition, and PCR is unique to Mississippi.

The PCR is a number from 0-100 which reflects the overall condition of the pavement, with 100 being new pavement with no defects. This number can be used to aid in prioritization of pavement. Below are some PCR range guidelines for 1987 Four-Lane roads, and for state-maintained roads which are not part of the 1987 Four-Lane Program:

Off 1987 Four Lane

Type	<u>Description</u>	<u>PCR Range</u>
Very Good	New or almost new pavement, will not require improvement for some time.	≥ 82
Good	In satisfactory condition, will not require improvement in near future.	$72 \leq x < 82$
Fair	Will likely need improvement in the near future, but depends on traffic use.	$62 \leq x < 72$
Poor	Needs improvement in the near future, to preserve usability.	$52 \leq x < 62$
Very Poor	Needs immediate improvement to restore serviceability.	< 52

1987 Four Lane

Type	<u>Description</u>	<u>PCR Range</u>
Very Good	New or almost new pavement, will not require improvement for some time.	≥ 89
Good	In satisfactory condition, will not require improvement in near future.	$82 \leq x < 89$
Fair	Will likely need improvement in the near future, but depends on traffic use.	$73 \leq x < 82$
Poor	Needs improvement in the near future, to preserve usability.	$63 \leq x < 73$
Very Poor	Needs immediate improvement to restore serviceability.	< 63

Since the 1987 Four-Lane Program roads sustain more traffic and handle more demand, the PCRs at which improvements need to be done are higher for the 1987 Four-Lane roads. More traffic, especially heavy truck traffic, means faster deterioration. In order to keep up with the higher demand and prevent rapid deterioration, improvements must be done sooner in the life of the pavement to prevent the underlying base and subgrade layers from deteriorating also. That is why the “critical” PCRs are a little lower on the non-1987-Four-Lane routes.

Pavement Analysis Package (PAP) is a tool used to perform long-term pavement management functions such as life-cycle cost analysis, cost-benefit analysis, pavement deterioration prediction, and recommendation of appropriate treatments. Prediction models for pavement deterioration were developed by the University of Mississippi Civil Engineering Department. Based on these models, one can go through decision trees which suggest certain treatments for rehabilitation projects. Budgeting, traffic and user delay costs are also incorporated into PAP for analysis regarding prioritization of

projects. Like any software, PAP does not make the actual decisions—it is a way to analyze information for personnel to come to their own conclusions.

Uses of Pavement Management Data

Pavement management data is collected and maintained to aid MDOT management in making decisions regarding project priority, funding, and program development.

- Deflection data are used to recommend overlay thicknesses to the Districts.
- Various research projects make use of the construction history and material properties information.
- MDOT has let its first warranty job contract, which was aided by pavement management data. Standards for job acceptance based on pavement condition were developed, and a representative CD-ROM was made showing typical distress features and severity levels. This CD-ROM will be used to illustrate to contractors what is and is not acceptable for warranty jobs in the future.
- The Chief Engineer is using PMS data to show how pavement condition declines over time if maintenance is not done in order to request funding for the state's four-lane system. PMS data supports the idea of pavements being a long-term investment.